UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Electrification Administration
St. Louis, Missouri

FIELD MEMORANDUM

See revised edition of 5-17-43

August 22, 1942

FOOD PRESERVATION BY ELECTRICAL DEHYDRATION

Food Preparation, Dehydration Operation; Construction Plans and Bill of Materials

TO ALL SYSTEM SUPERINTENDENTS AND MANAGERS:

The present emergency has stimulated considerable interest in electrical dehydration as a means of preservation of the farm family's food supply. Victory gardens are producing the highly nutritious vegetables which must be preserved in spite of shortages of tin cans, fruit jars, lids and rubber. Pressure cookers are also off the market. Therefore, at this time, we look for another satisfactory and safe means of preserving our food. Electrical dehydration seems to be our best answer to the problem because by this means of food preservation, the nutritional value of the food is largely retained and the required number of containers made from critical materials is greatly reduced. Electrical dehydration costs compare favorably with canning costs, and when properly prepared and dehydrated, the food is equally appetizing.

REA engineers have designed and tested an electrical dehydrator which can be constructed by the farmer, himself. A minimum amount of critical materials is required in the construction. The dehydrator can be built for $23 or less.

Your members will be interested in knowing about this dehydrator. I would like to urge you to build one, according to the attached specifications, for display and demonstration purposes. Invite your members to inspect it and build one for themselves. I suggest that you publicize this through your newsletter.

Homemakers will also need full information of preparation of foods for dehydration and operation of the dehydrator in order to secure the best results. The attached information has been prepared for that purpose.

Due to the shortage of paper, additional copies will not be available through this office. I suggest that you mimeograph copies for your members' use.

W. E. Herring

W. E. Herring, Chief
Cooperatives' Operations Division

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FOOD PRESERVATION BY ELECTRICAL DEHYDRATION

Introduction:

Preservation of food by dehydration is particularly practical for the farm family at this time, as it represents a great saving in the number of tin cans, jars, and other containers needed to preserve the yearly family food supply. Drying reduces the volume of the food one-fourth to one-ninth the original volume.

Drying by dehydration can be accomplished in a shorter time than by sun-drying, and consequently there is less danger of fermentation and insect infestation during drying. Dehydration, in most cases, produces a superior product in color, flavor and nutritive value.

If properly prepared, blanched and dehydrated, foods will retain much of their original vitamin content. Vitamin C is most easily destroyed during dehydration. Dried foods cannot be depended upon as a source of Vitamin C.

Steam blanching is preferable to water blanching because it tends to preserve the vitamins and minerals.

Varieties of Vegetables Suitable for Dehydration

Information on varieties of all vegetables best suited to dehydration is not available. Generally speaking, the satisfactory types are usually well-colored and possess characteristic flavors of the vegetable. Weakly-colored and flavored vegetables are unsatisfactory. The following varieties of vegetables are recommended:

Corn - Any of the sweet varieties used on the table: Stowells Evergreen, Country Gentlemen, and Golden Bantam are excellent.
Beets - Dark, red, solid color beet such as Detroit Red.
Cabbage - Savoy, Danish, Domestic and Pointed Head varieties are satisfactory. Kraut varieties are not suitable for dehydration.
Carrots - Chantenay, Morse Bunching and Imperator varieties.
Onions - (1) Evenezer, White Portugal, Red Creole and White Creole are excellent.
(2) Early Yellow Globe, Mountain Danvers, Ohio Yellow Globe, Red Wethersfield, Southport Red, Yellow and White Globes, Brigham Yellow Globe, Yellow Globe Danvers may be used and blended with those of (1). (Sweet Spanish and Australian Browns are not suitable for dehydration)
Potatoes, Irish - Mealy varieties are most satisfactory. Idaho Russet, Oregon Gems, Klamoth Russets, and Burbanks are good. Irish Cobbler, Early Ohio, Chippewa and Bliss Triumph are also satisfactory.
Potatoes, Sweet - Both soft "yam" and hard starchy varieties are suitable for drying. The best varieties are Puerto Rican, Maryland Sweets, Key West, Jersey and Nancy Hall.
Rutabagas - American Purple Top, Bangholm, and Early Neckless

Varieties of Fruits Suitable for Dehydration

Apricots - Blenheim, Royal, Tilton
Figs - Adriatic, Black Mission, Calemyrna, Kadota
Nectarines - Hardwick, Newboy, Quetta, Stanwick

Peaches (Clingstone) - Mid-summer varieties and Phillips
Peaches (Freestone) - Elberta, Lovell, Muir
Pears - Bartlett
Prunes - French Imperial, Sugar, Robe de Sergeant
Raisins (natural) - Muscat, Sultana, Thompson Seedless
Currants - Black Corinth

Preparation of Food for Drying

Selection:

Vegetables for dehydration should be garden fresh. They should be harvested either early or late in the day to avoid heat and direct rays of the sun. Mature sound vegetables should be selected. Immature vegetables are weak in color and flavor, while overmature vegetables are usually tough and woody.

Fruits should be thoroughly matured and ripened before harvesting.

Fruits and vegetables should be dehydrated the same day as harvested, if possible. In case it is necessary to store them, they should be kept in a refrigerator to avoid loss of vitamin content. Exceptions are pumpkin, Irish and sweet potatoes, which may be stored before dehydration.

Preparation:

Vegetables should be thoroughly washed, peeled and trimmed. The method of preparation and form for drying will depend upon the characteristics of the vegetable. The form for drying of the various vegetables and fruits are given in Table I. Care should be taken to have slices, strips or cubes of uniform size, so that drying will take place evenly throughout the trays.

Blanching:

Steam blanching is preferable to water blanching in order to retain as much as possible of the original minerals, vitamins and other food value. Blanching inactivates the enzymes which cause discoloration, "off flavor" and destruction of vitamins. The blanching time will depend on the vegetable and the size of the pieces. Blanching time of vegetables is given in Table I.

Steam blanching may be carried out by placing the vegetables in a cheesecloth bag or wire basket to which long heavy cord or wire handles have been attached. The bags are suspended in the upper portion of a wash boiler one-fourth full of boiling water. The handles should extend over the sides of the boiler and be held by the lid to prevent the handles from being submerged. A supporting rack frame stand or large pot should be used to keep the vegetables out of the water and to enable the steam to reach all portions of the vegetables equally well. This insures uniform blanching. The water in the boiler should be kept boiling during the blanching period.

Preparation of Fruits for Drying

Apples may be dipped in salt water as soon as sliced, to prevent discoloration. Add three to five teaspoons of salt to each gallon of water. Halves of apricots and peaches should be steamed until cooked through before placing in the dehydrator. Sulfuring of fruits is not advised when they are to be dried in the electric dehydrator, because of chemical reaction of sulfur fumes on the metal of the electrical equipment. Figs, grapes and prunes should be dipped in boiling lye with subsequent cold water rinse. The lye solution should be from 1 to 3% in strength.

Special

These instructions for preparation of food and procedure in dehydration apply to the use of this particular dehydrator and may not apply to dehydration in general.

Operation of the Dehydrator

Vegetables and fruits should be dehydrated immediately following blanching or other recommended treatment. They should be spread evenly over the trays, about one-half inch thick. Cheesecloth may be spread over trays for such vegetables as corn and those which have a tendency to stick to the trays.

The dehydrator may be preheated to 130° F. or higher, for many foods, or drying may be started in the cold dehydrator. Care should be taken to see that the dehydrator temperature does not go above the maximum finishing temperature given in Table I. To avoid loss of heat, the dehydrator should be opened only when necessary. If excessive loads are not used on the trays, stirring will be unnecessary and even drying will take place. In some cases, it may be necessary to rearrange the trays in order to obtain uniform drying. The attached dehydrator plans indicate the installation of two switches to control the various heating elements to prevent too high temperatures within the dehydrator, especially during the last few hours of the drying period.

Drying time

The drying time will vary with the type of food material and the quantity to be dried. For fruits, the drying time will vary from 4 to 30 hours. Vegetables will require from 3 to 18 hours for drying. The end of the drying period will be determined by the characteristics of the product, as described in Table I. If the drying time is too long, this indicates that too much food is being placed in the dehydrator at one time, or there are insufficient heating elements in use. The quality of the dried product will also be inferior if the drying time is lengthened. The time to remove the product from the dehydrator will be determined by the appearance of the product, the tendency for the temperature to rise above the maximum, safe, final temperature and the physical condition of the dried product. Cutoff switches enable the operator to reduce the temperature by controlling the heating elements when the temperature rises above the maximum,

given in Table I, and before the product is sufficiently dehydrated. In some cases, the heat must be reduced and the air discharge port completely opened two or three hours before dehydration is finished, in order to keep the temperature sufficiently low. The exhaust opening is adjustable and should be closed at the start of the dehydration period. When the temperature reaches 130° F., the slide should be opened 1/8 of an inch and adjusted thereafter to control the temperature.

TABLE II

FRUITS	QUANTITY	APPROXIMATE DRYING TIME
Apples	35 lbs.	6-10 hours
Apricots	50 lbs.	10-20 hours
Cherries	25 lbs.	8-12 hours
Cranberries	20 lbs.	4-8 hours
Figs	75 lbs.	10-20 hours
Grapes	85 lbs.	20-30 hours
Loganberries	30 lbs.	10-15 hours
Peaches	65 lbs.	15-24 hours
Pears	65 lbs.	15-24 hours
Prunes	75 lbs.	20-30 hours
Raspberried (black)	25 lbs.	10-15 hours
Rhubarb	25 lbs.	10-15 hours
VEGETABLES	**QUANTITY**	**APPROXIMATE DRYING TIME**
Beans (green)	20 lbs.	8-12 hours
Beets	30 lbs.	8-12 hours
Cabbage	25 lbs.	8-12 hours
Carrots	35 lbs.	8-12 hours
Celery	25 lbs.	3-6 hours (leaves) 8-10 hours (stalks)
Corn	40 lbs.	5-10 hours
Onions	30 lbs.	5-10 hours
Parsnips	30 lbs.	8-12 hours
Peas	25 lbs.	8-12 hours
Potatoes	30 lbs.	8-12 hours
Pumpkins	35 lbs.	12-16 hours
Squash	35 lbs.	14-18 hours
Spinach, chard mustard greens	12 lbs.	6-10 hours
Sweet Potatoes	35 lbs.	5-10 hours
Tomatoes	30 lbs.	10-14 hours
Turnips	30 lbs.	8-12 hours

Calculated from recommended tray load given by "Preservation of Fruits and Vegetables by Commercial Dehydration" by E. M. Chace, W. A. Noel and V. A. Pease. U. S. D. A. Circular 619, 1941.

TABLE I

* SUMMARY OF DEHYDRATION PROCEDURES FOR FRUITS

FRUIT	FORM FOR DRYING	TREATMENT	MAXIMUM FINISHING DRYING TEMP. °F.	APPEARANCE WHEN DRIED
Apples	Peel, core, trim, cubes or slices	Salt water	140-160	Dry, springy
Apricots	Wash, halve and stone	Steam	135-155	Dry, leathery
Cherries (unpitted)	Wash, stem, whole	None or steam two minutes	135-160	Slightly moist, limber
Cherries, sweet (pitted)	" " "	None or steam two minutes	135-160	Slightly moist, limber
Cranberries	Chopped pieces	None or steam two minutes	135-150	Dry, tough to brittle
Figs	Wash, whole	1-3% lye solution, 1/12-1/2 min. Dip in fresh cold water	135-160	Skin dry, glossy, flesh slightly moist
Grapes	Stem and seed after drying, Subdivide clusters.	Boiling lye dip as for figs	150-160	Skin dry, glossy, Flesh slightly moist
Loganberries	Wash, whole	None	140-150	Dry, should not crumble
Peaches	halve, pit, peel	Steam	145-155	Dry, leathery
Prunes	Whole, grade for size	Boiling lye dip as for figs 1/6 - 3/4 min.	145-160	Skin dry, flesh slightly moistened
Raspberries	Wash, whole	None	140-150	Dry, should not crumble

*"From Preservation of Fruits and Vegetables by Commercial Dehydration" by E. M. Chace, . . . Noel and V. A. Pease. U. S. D. A. Circular No. 619. 1941.

TABLE I (Continued)

* SUMMARY OF DEHYDRATION PROCEDURES FOR VARIOUS VEGETABLES

VEGETABLES	FORM FOR DRYING	BLANCHING	MAX. FINISH DRYING TEMP. DEGREES F.	CHARACTERISTICS WHEN DRIED
Asparagus	Cut to short tips	Steam 10-12 min.	145	
Broccoli	Stalks, trimmed	Steam 10-12 min.	150	
Beets	Sliced or diced	Cooked 20-30 min. in steam before peeling	150	Curled, tough
Brussels Sprouts	Cut in half	Steam 5-10 min.	150	
Beans, green	Cut 3/4 in. lengths	Steam 10-12 min.	155	Dry, tough to brittle
Cabbage	Thin slices	Steam 2 min.	150	Dry, ribs tough, leaves crisp
Carrots	Peeled, diced, sliced or shredded	Steam 6-10 min.	160	Dry, tough to brittle
Celery	Short lengths, 3/4 in. or shredded	Steam 1-2 min.	145	Dry, stalks tough, leaves crisp
Chard	Trimmed, washed leaves	Steam 3-5 min.	150	Dry, crisp
Corn	Cut from cob after blanching	Steam 15-20 min. on cob	160	Dry, brittle
Garlic	Sliced	Steam 1-2 min. or no blanch if for powder	145	
Horse beans				
Jerusalem Artichokes	Shelled Sliced	Steam 5-10 min. Steam 4-5 min.	145 160	
Kale	Trimmed leaves	Steam 3-5 min.	150	
Green lima beans	Shelled	Steam 5-10 min.	150	
Onions	Peeled, sliced thin	No blanch or only 1-2 min. in steam	140	Dry, crisp

* From "What's Known Today about Dehydrating Vegetables" by W. M. Cruess and E. M. Mrak. Food Industries, 14:48 March 1942

and "Preservation of Fruits and Vegetables by Commercial Dehydration" by E. M. Chace, W. A. Noel and V. A. Pease. U. S. D. A. Circular No. 619., 1941

TABLE I (Continued)

SUMMARY OF DEHYDRATION PROCEDURES FOR VARIOUS VEGETABLES

VEGETABLE	FORM FOR DRYING	BLANCHING	MAX. FINISH. DRYING TEMP. DEGREES F.	CHARACTERISTICS WHEN DRIED
Okra	Sliced	Steam 4-8 min.	150	
Mushrooms	Whole, stalks sliced (peeled preferably)	Steam 5-8 min.	150	
Parsnips	Peeled, sliced, diced or shredded	Steam 6-10 min.	160	Dry, tough to brittle
Peas	Shelled	Steam 5-10 min.	150	Dry, hard, wrinkled
Peppers and pimentos	Whole	No blanch.	160	
Potatoes, Irish	Peeled, sliced, diced or riced	Steam 5-10 min.	150	Dry, brittle
Potatoes, Sweet	Peeled, diced, sliced or riced	Usually cooked before peeling, Otherwise steam 6-8 min.	160	Dry, brittle
Pumpkin and sliced yellow squash	Sliced	Steam 4-6 min.	160	Dry, tough
Rhubarb	Lengths 3/4 to 1 in.	Steam 2 min.	160	Dry, tough
Spinach	Trimmed leaves	Steam 2-5 min.	150	Dry, crisp
Summer squash and Zucchini	Sliced	Steam 4-6 min.	150	Dry, tough
Tomatoes for stewing	Peeled, sliced	Steam 1-2 min.	150	Dry, brittle
Tomatoes for powdering	Cored and sliced, not peeled	No blanch, or steam 2 min.	150	
Turnips and rutabagas	Peeled, sliced, diced or shredded	Steam 6-10 min.	150	Dry, tough to brittle

Care and Storage of Dehydrated Foods

Products direct from the dehydrator are never uniformly dry. They should be kept in covered containers, and a daily stirring is advisable to mix the more moist pieces with the drier ones. The product should be packed in air-tight, moisture-proof containers, such as glass jars, metal cans with lids or moisture-proof paper bags. The product should be packed immediately after coming from the dehydrator, as mold and other forms of deterioration may take place. Small containers for home use are most practical. Dried products should be stored in a warm dry room and, if glass jars are used, as much of the sunlight as possible should be excluded. The ordinary pantry or storeroom off the kitchen is usually not dry enough for storage of dried food. In damp climates, or during rainy seasons, packages of dried foods should be examined occasionally, and if any of the products are absorbing moisture, they should be returned to the dehydrator and dried to restore them to their original dry condition.

Cooking and Use of Dried Foods

Dried fruits and vegetables should be soaked in water about five to eight times their volume, for several hours, depending on the product. In cooking, the soaking water should be used. Dried foods do not require as long a cooking period as the fresh food.

Bibliography

1. "What's Known Today About Dehydrating Vegetables", M. V. Cruess and E. M. Mrak. Food Industries Volume 14, Nos. 1, 2, 3, 4 - 1942
2. "Preservation of Fruits and Vegetables by Commercial Dehydration" E. M. Chase, W. A. Noel and V. A. Pease, U.S.D.A. Circ. #619, 1941
3. "Farm and Home Drying of Fruits and Vegetables", Joseph S. Caldwell U.S.D.A. Farmers Bulletin #984, 1933 (revised)
4. "Nutritive Value of Dried and Dehydrated Fruits and Vegetables" D. K. Tressler, N. Y. State Experiment Station Technical Bulletin, 1942
5. "Information Sheets on Dehydrated Vegetables" Dehydration Committee Bureau of Agricultural Chemistry and Engineering, U.S.D.A. Mimeographed Copy ACE 165-171
6. "Experiments on Drying Unsulfured Apricots and Peaches" M. V. Cruess, Fruit Products Journal. 21:135. 1942
7. "Methods and Equipment for the Sun Drying of Fruits" E. M. Mrak and J. D. Long. University of California Experiment Station Circular #350, 1941
8. "Home Canning Costs" V. Enid Sater, State College of Washington, Agricultural Station Bulletin #337, 1936

Cost of Dehydration versus Canning

The cost of dehydration will vary somewhat with the product and the same is true of canning. An average cost of dehydration and storage of a year's food supply for a family of five (400 quarts canned or 133 pounds dried food) has been

calculated to be $23, where the dried food is stored in quart glass jars. This cost includes annual depreciation on the dehydrator and cost of electricity for dehydration at 3¢ per kilowatt hour, but doesn't include the cost of the labor and food materials.

When double walled moisture-proof paper bags are substituted for glass fruit jars, the annual cost of dehydrating and storing the same quantity of food may be reduced to $19.66.

The canning cost of 400 quarts of food, using a pressure cooker and stored in quart glass jars was estimated to be $20.64, when electricity at 3¢ per kilowatt hour was used as fuel. This does not include the cost of labor and food materials. In comparing costs of canning and dehydration, it should be considered that pressure cookers for canning are not on the market at the present time. Non-acid vegetables should be canned with a pressure cooker if safekeeping is to be assured. Dehydration of these vegetables may be the alternative method of safe preservation and has the added advantage of saving many jars, rubbers and lids.

(Calculated from data given by "Home Canning Costs", State College of Washington, Agricultural Experiment Station Bulletin No. 337, 1936, P. 24)

BILL OF MATERIALS FOR HOMEMADE ELECTRIC DEHYDRATOR

LUMBER

Number	Unit	Kind	Size	Use
4	Pieces	#1 common pine	1"x2"x20 3/4"	Bottom and top
8	"	" " "	1"x2"x52 3/4"	Bottom, top and sides
4	"	" " "	1"x2"x30½"	Sides
8	"	" " "	1"x2"x19"	Back, front and doors
2	"	" " "	1"x2"x14"	Fan door
2	"	" " "	1"x2"x16½"	Back
2	"	" " "	1"x2"x11"	Front
2	"	" " "	1"x2"x19½"	Door
		(All 1 x 2 material 7/8 x 2 net)		
1	Piece	Plywood	½ x 18 x 51	Bottom
1	"	"	¼ x 18 x 36	Slanting baffle
1	"	"	¼ x 18 x 12½	Vertical baffle
2	Pieces	"	¼ x 12 x 17	Exhaust door
1	Piece	"	1/8 x 18 x 18	curved baffle*
		*Sheet metal or cardboard may be used for this		
44	Pieces	#1 common pine	½ x 1 x 17 3/4	Trays
22	"	" " "	½ x 1 x 16 3/4	"
22	"	" " "	½ x 1 x 15 3/4	"
8	"	" " "	½ x 1 x 49	Tray slides
2	"	" " "	½ x 1 x 41	" "
2	"	" " "	½ x 1 x 25	" "
2	"	" " "	½ x 1 x 12	Vertical baffle support
1	"	" " "	½ x 1 x 18	" " " "
2	"	" " "	½ x 1 x 36	Slanting baffle support
1	Piece	Insulating board	½ x 18 x 51	Bottom
2	Pieces	" " "	½ x 30 x 51	Sides
1	Piece	" " "	½ x 19 x 51	Top
1	"	" " "	½ x 18 x 16	Back
1	"	" " "	½ x 18 x 13	Fan door
1	"	" " "	½ x 18 x 10	Front
1	"	" " "	½ x 18 x 19	Door

HARDWARE

Number	Unit	Kind	Size	Use
1	Box	Round head Wood screws	#6 - 1"	Fasten insulating board to frame and tray slides to insulating board
7	Dozen	Flat head wood screws	#8 - 3/4"	Fasten joints of frame
1	Box.	" " "	#6 - 1"	Trays
4	Dozen	" " "	#8 - 2"	Final assembly
½	Pound	Steel Washers	3/16"	Used when screws are put through insulating board

HARDWARE (continued)

Number	Unit	Kind	Size	Use
1	only	Carriage bolt	$\frac{1}{4}$" x $1\frac{1}{2}$"	Exhaust door
1	"	Washer	large $\frac{1}{4}$" hole	" "
2	pairs	Narrow butt hinges	3/4" x $2\frac{1}{2}$"	Doors
2	only	Screen door handles	$2\frac{1}{2}$"	"
2	"	Door bolts	Small	"
25	square ft (or equal amount of cheesecloth	Copper screen or muslin)	16 mesh	Trays
1	piece	Asbestos paper	19" x 38"	Slanting baffle

ELECTRICAL EQUIPMENT

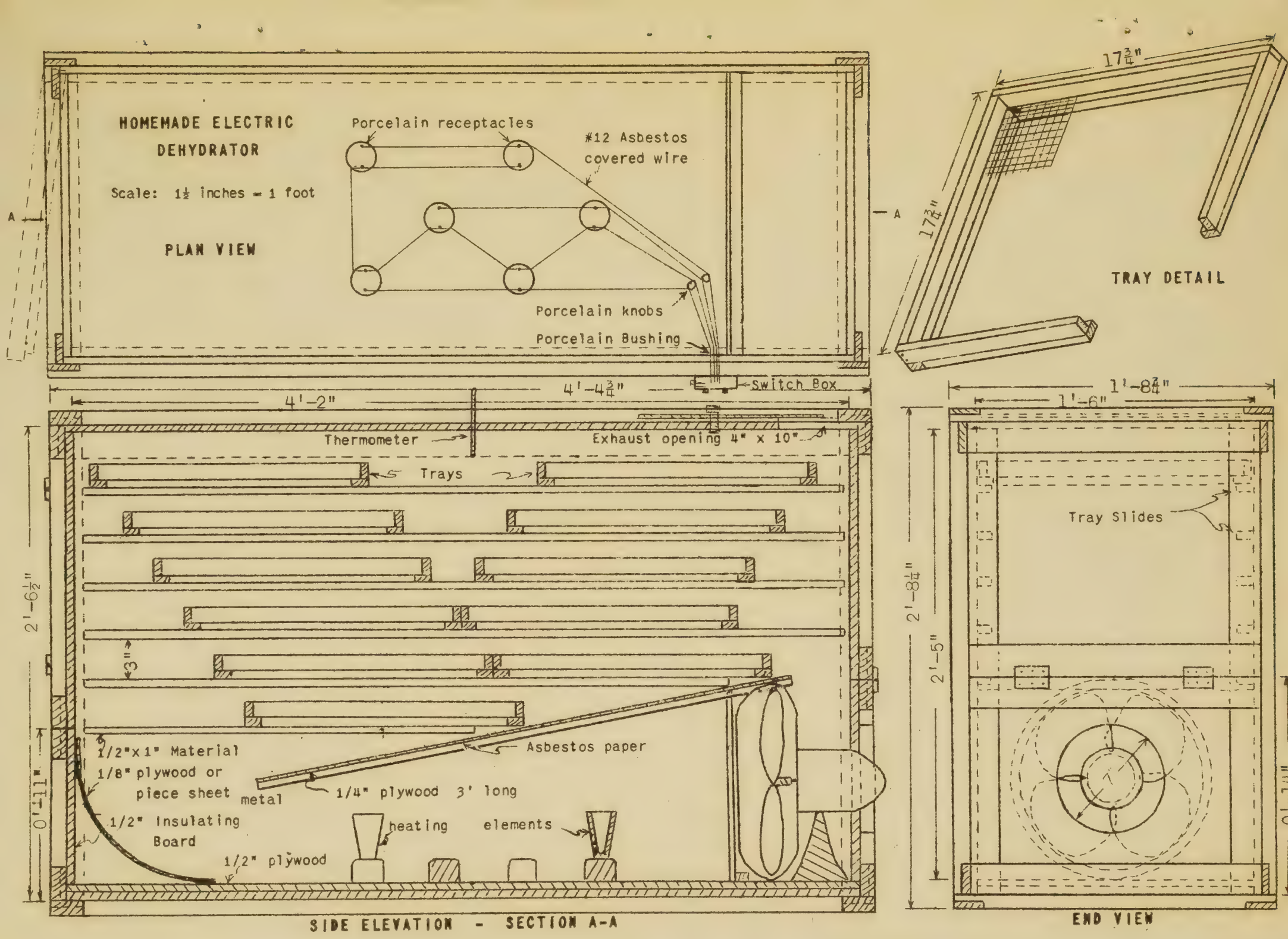
1 Junction Box with 2 toggle switches and cover
1 $\frac{1}{2}$" cable connector
2 Porcelain bushings or tubes
3 or 6 porcelain sockets (depends on whether heating elements or light bulbs are used)
12' #12 Asbestos covered stranded wire (single)
10' #12 2-wire flexible cable (appliance cord)
3 500W socket type heating elements or
3 - 300W + 3 - 200W light bulbs

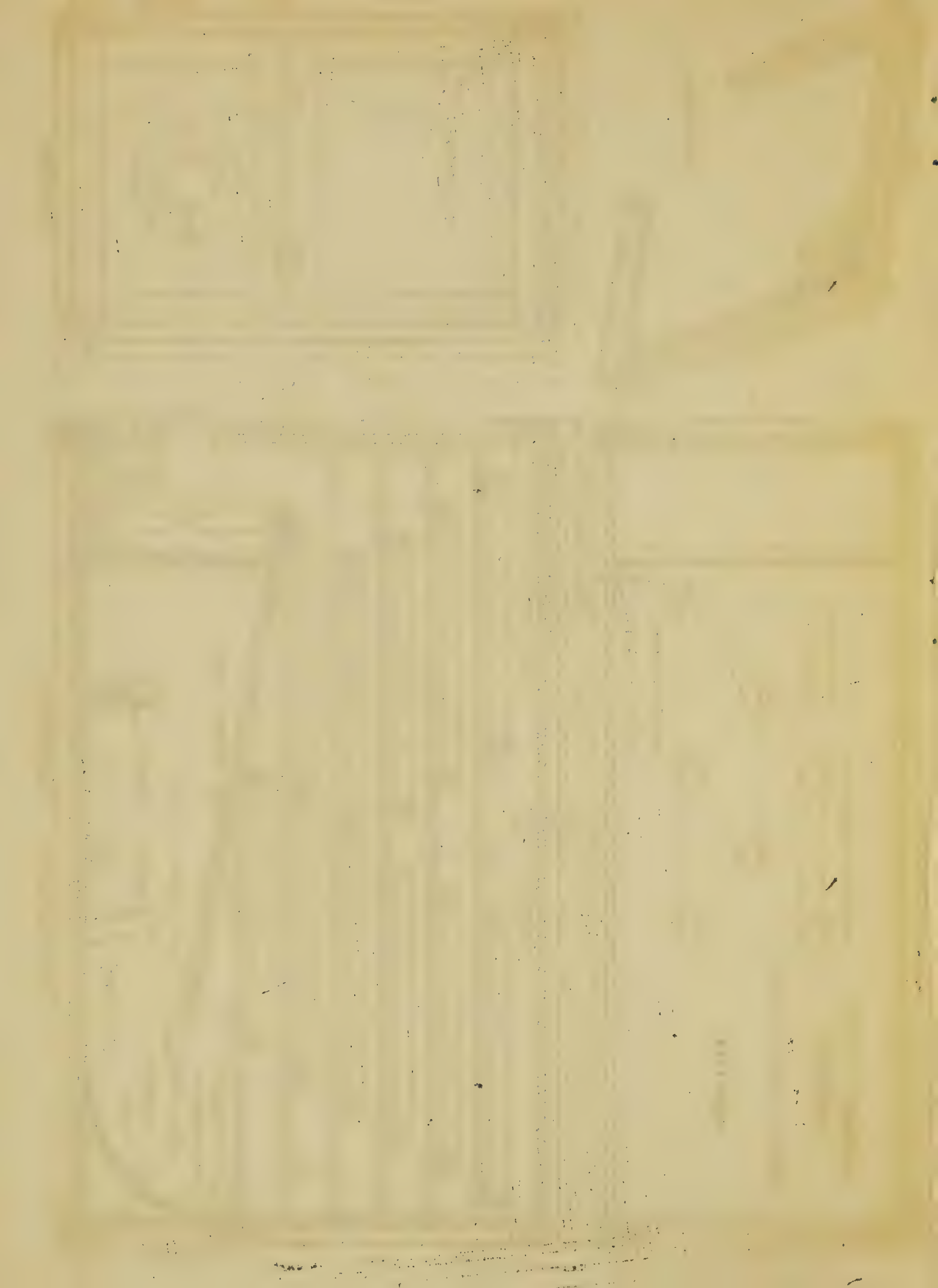
OTHER EQUIPMENT

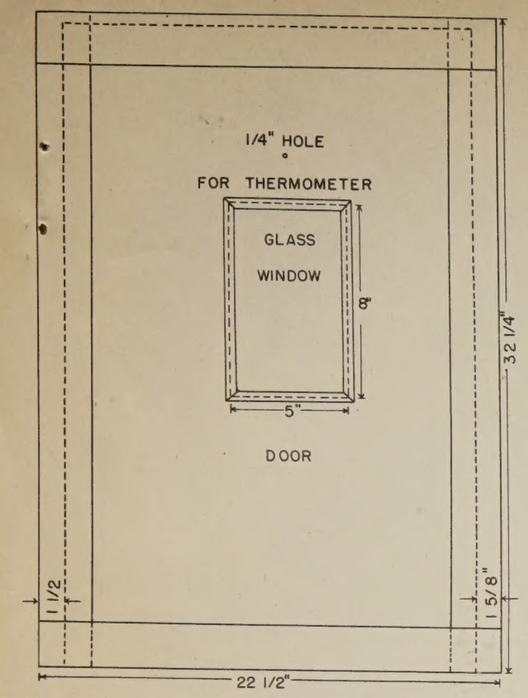
1 Household fan 8" to 12"
1 Thermometer-range 75° to 175° F

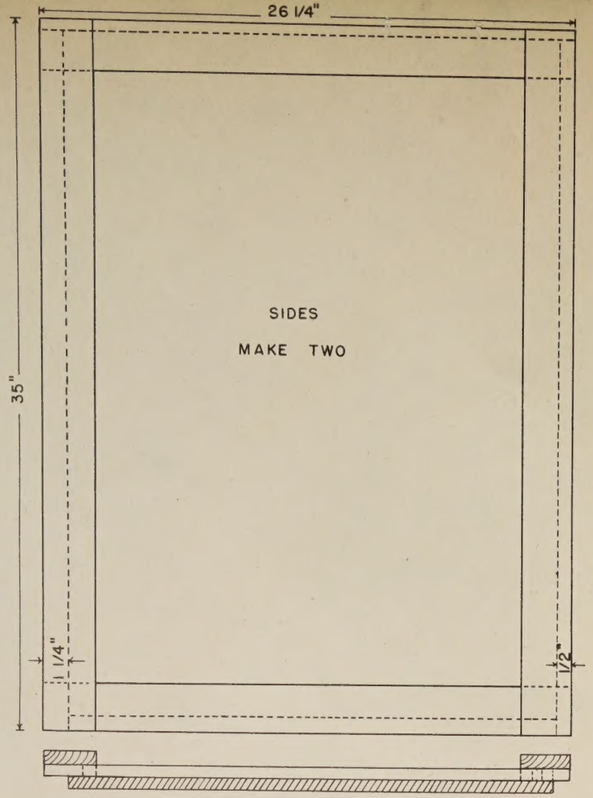
ESTIMATED COST

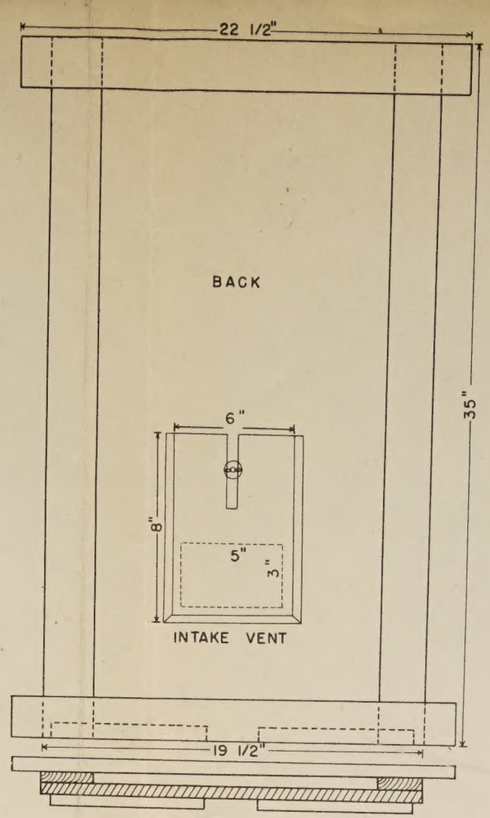
Material cost--------$18.60
Eight inch A.C. fan-- 5.00

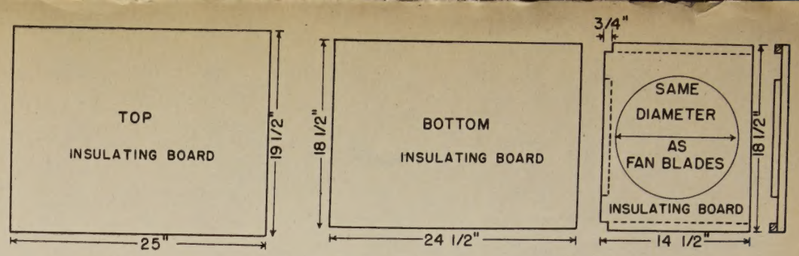

HOMEMADE ELECTRIC DEHYDRATOR
Scale: 1½ inches = 1 foot
PLAN VIEW
Porcelain receptacles
#12 Asbestos covered wire
Porcelain knobs
Porcelain Bushing
A
A
17¾"
17¾"
TRAY DETAIL
4'-2"
4'-4¾"
Switch Box
Thermometer
Exhaust opening 4" x 10"
Trays
2'-6½"
3"
0'-11"
1/2"x1" Material
1/8" plywood or piece sheet metal
1/2" Insulating Board
1/2" plywood
Asbestos paper
1/4" plywood 3' long
heating elements
1'-8¾"
1'-6"
Tray Slides
2'-8¼"
2'-5"
SIDE ELEVATION - SECTION A-A
END VIEW

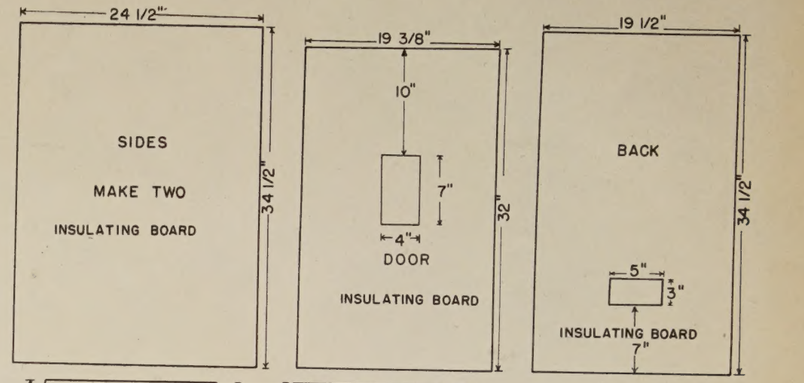


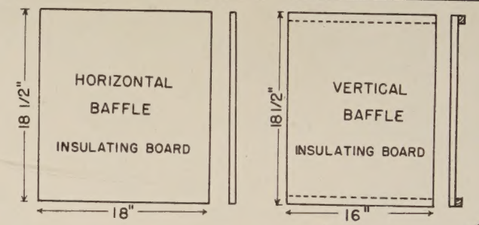


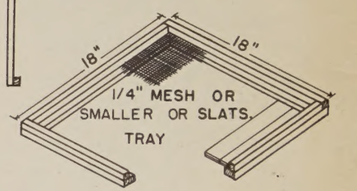


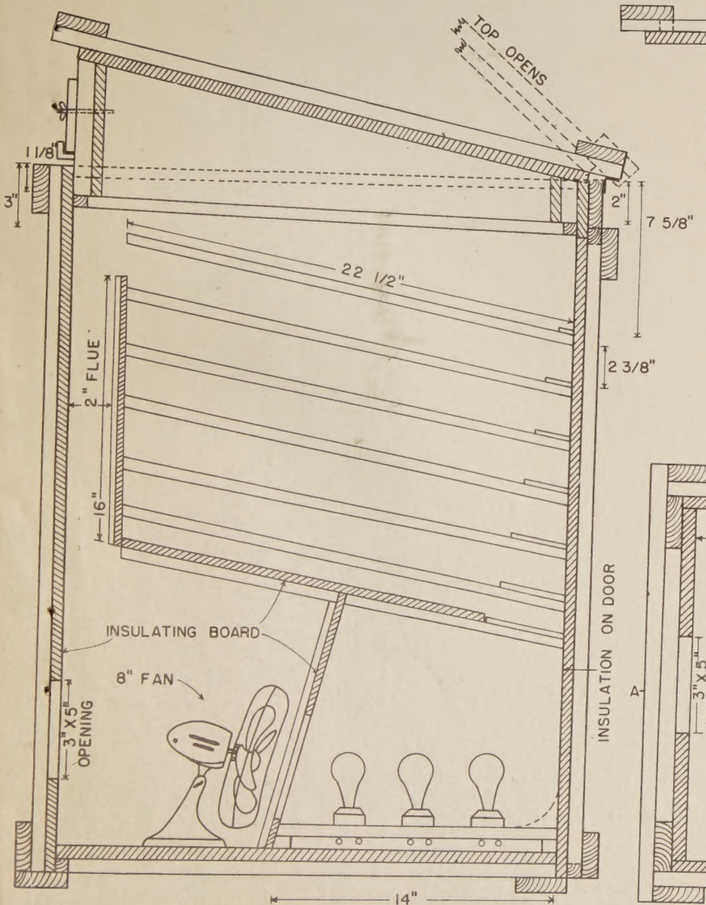


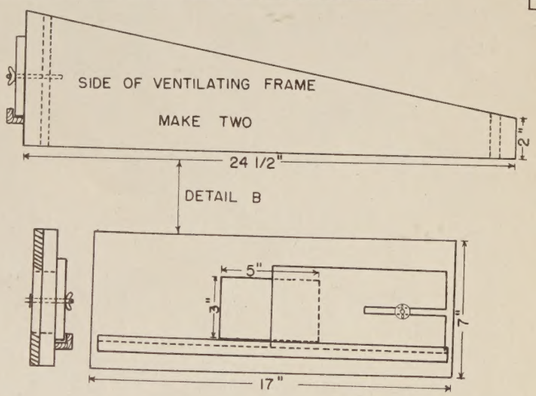


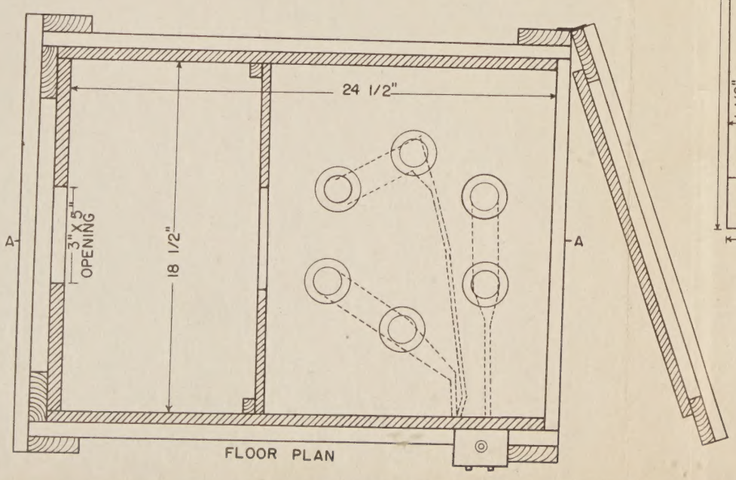


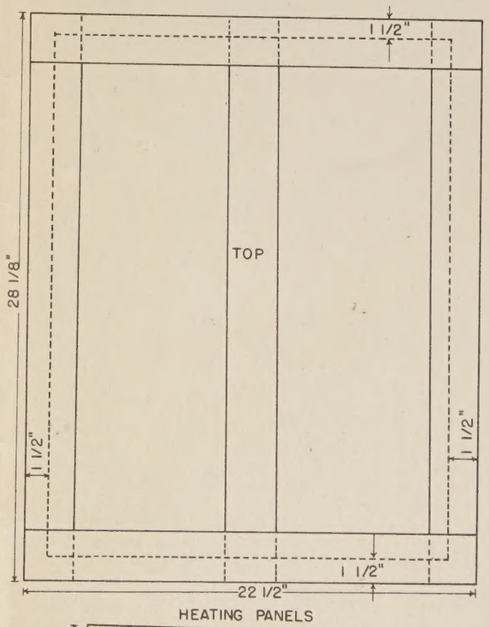


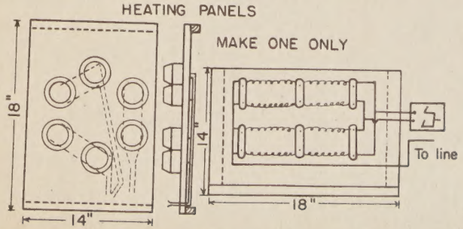


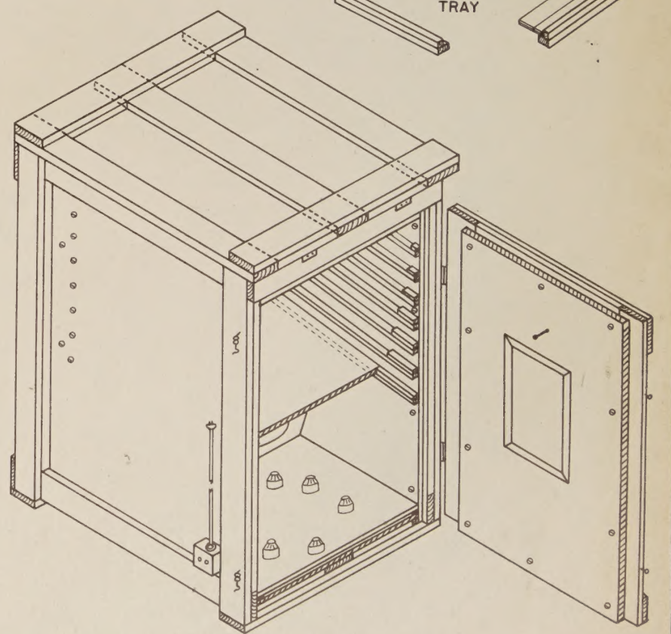






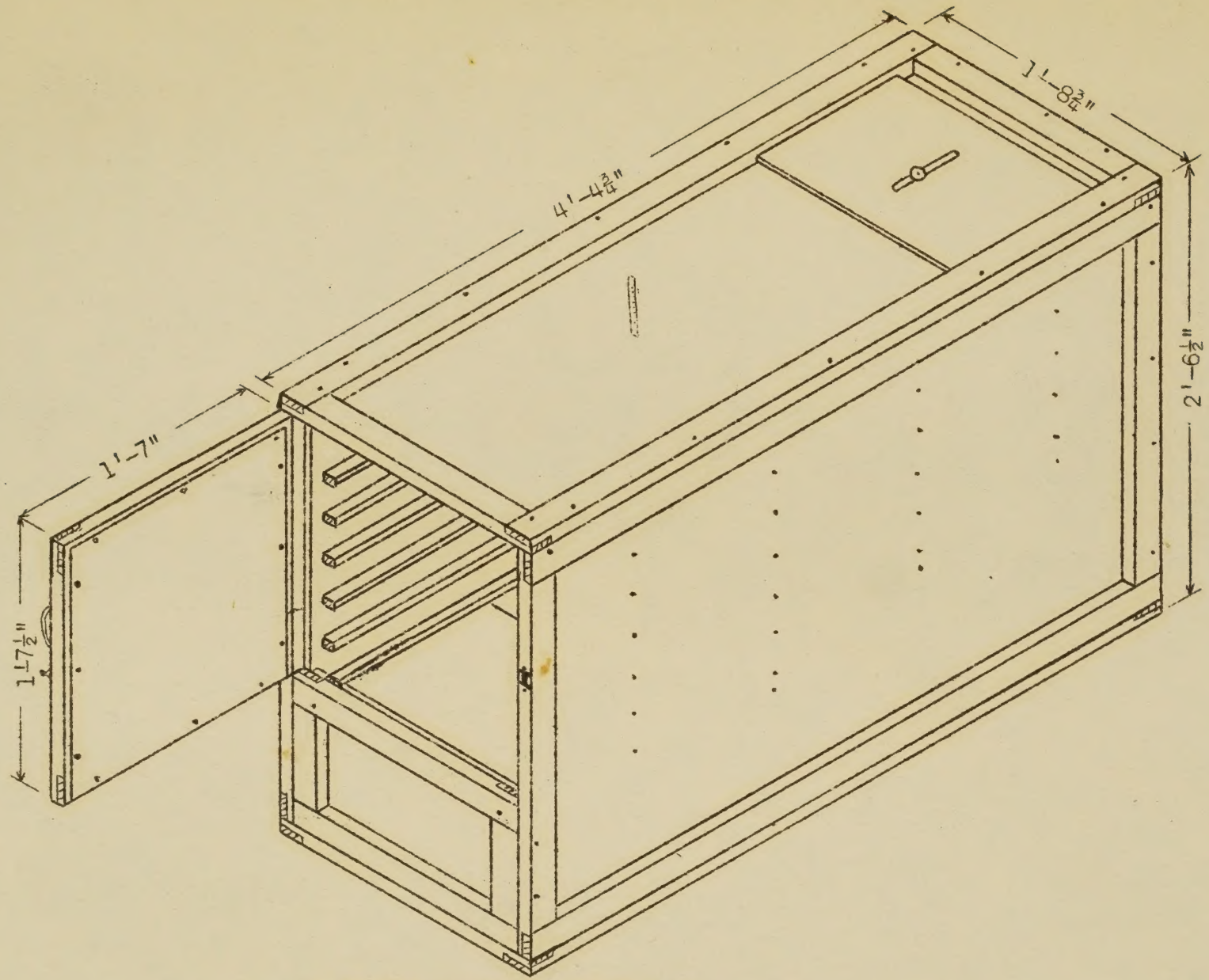






Scale 1/8" = 1"
1/16" = 1" Used for
Insulating Board Drawings

U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION
ELECTRIC DEHYDRATOR



HOMEMADE ELECTRIC DEHYDRATOR

Drawn By: B. L. Embry

Approved By: D. W. Teare

July 13, 1942

Scale: 1 inch = 1 foot